Performance of Mixed Layer Models in the Mediterranean Sea

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Motivation

The vertical mixing models in HYCOM

KPP	$\longrightarrow$	Large et al. (1994)
GISS	$\longrightarrow$	Canuto et al. (2002)
MY2.5	$\longrightarrow$	Mellor and Yamada (1982)
KT	$\longrightarrow$	Kraus and Turner (1967)
PWP	$\longrightarrow$	Price et al. (1986)

We would like to answer the question:
How do these different mixed layer models perform under a given atmospheric forcing?

Ocean Model

- **HYbrid Coordinate Ocean Model (HYCOM)**
- **Ocean basin:** Mediterranean Sea
  - 20–layers
  - 3 m top layer thickness
- **Model resolution:** $1/25^\circ \cos(lat) \times 1/25^\circ$
  - average grid resolution is $\approx 3.5\,\mathrm{km}$.

- **Heat fluxes:**
  - Shortwave radiation attenuation: turbidity
  - Blackbody longwave radiation correction
  - Bulk formulae for latent and sensible heat based on model SST

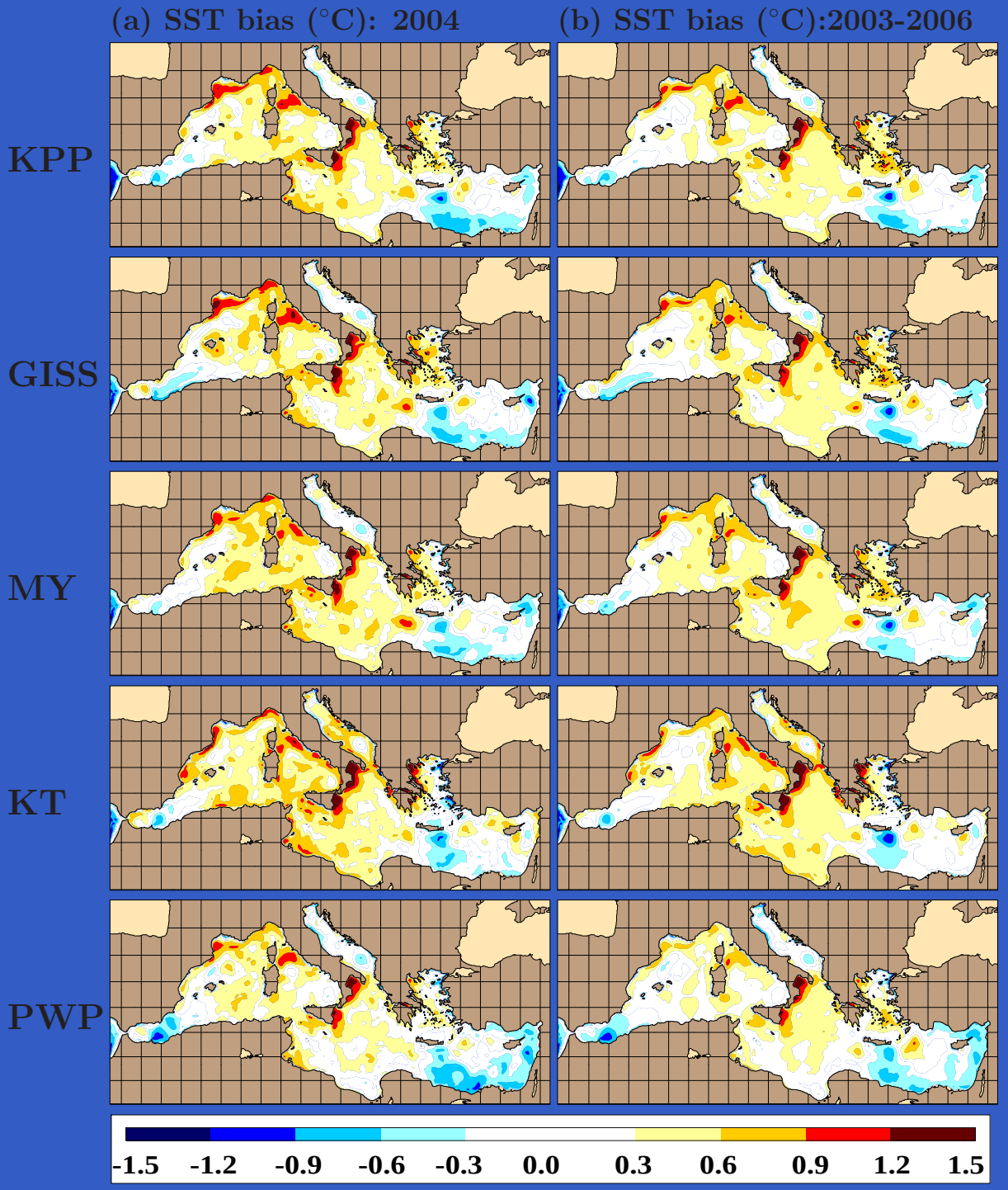
Mediterranean Sea HYCOM simulations

Simulation period	2003 through 2006
Atmospheric forcing	3 hourly NOGAPS
T and S initialization	GDEM3 climatology
Data assimilation	None
Relaxation to SST	None
Relaxation to salinity	sea surface salinity

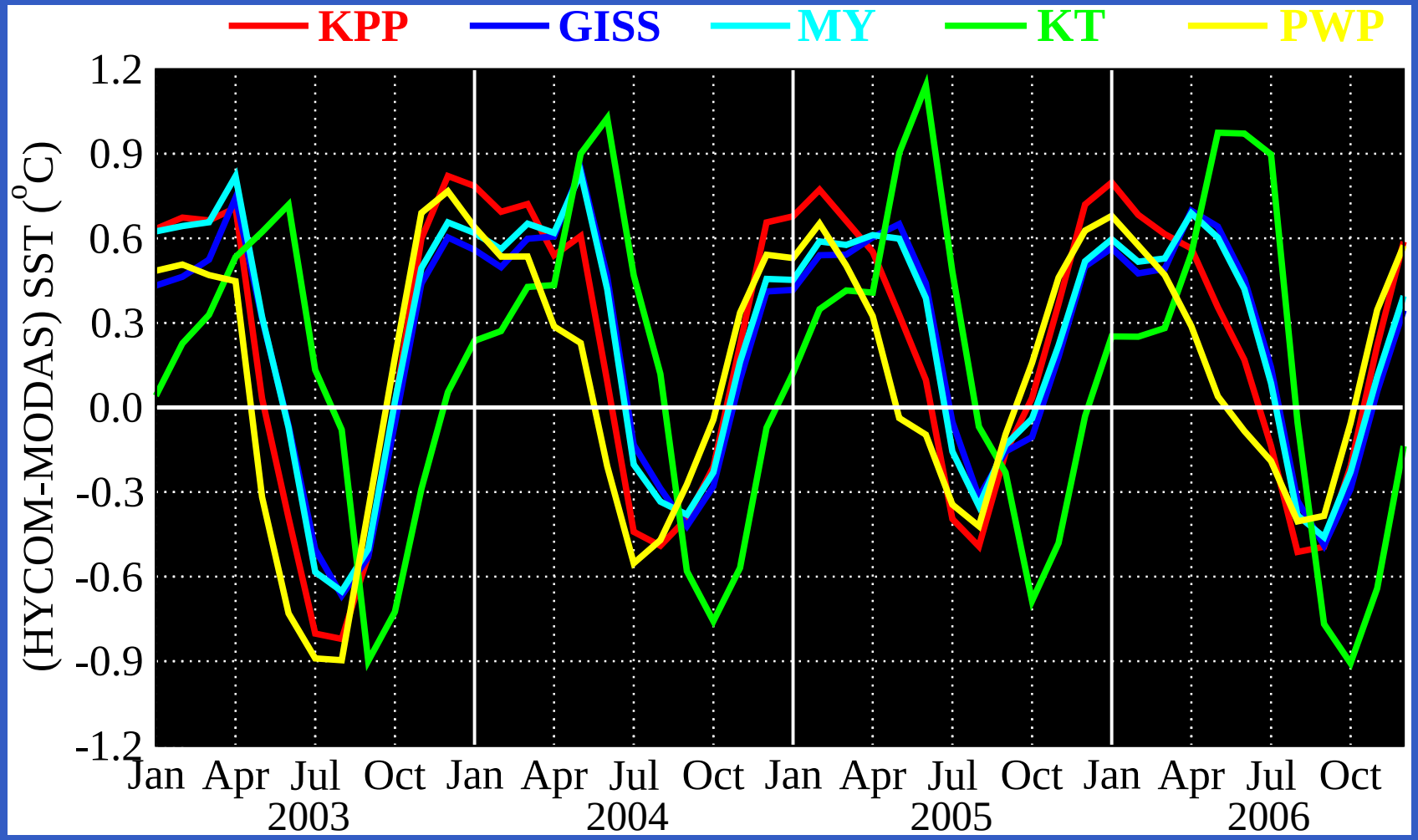
NOGAPS: Navy Operational Global Atmospheric Prediction System

GDEM: Generalized Digital Environmental Model (v3)

Mean SST Bias from Mixed Layer Models

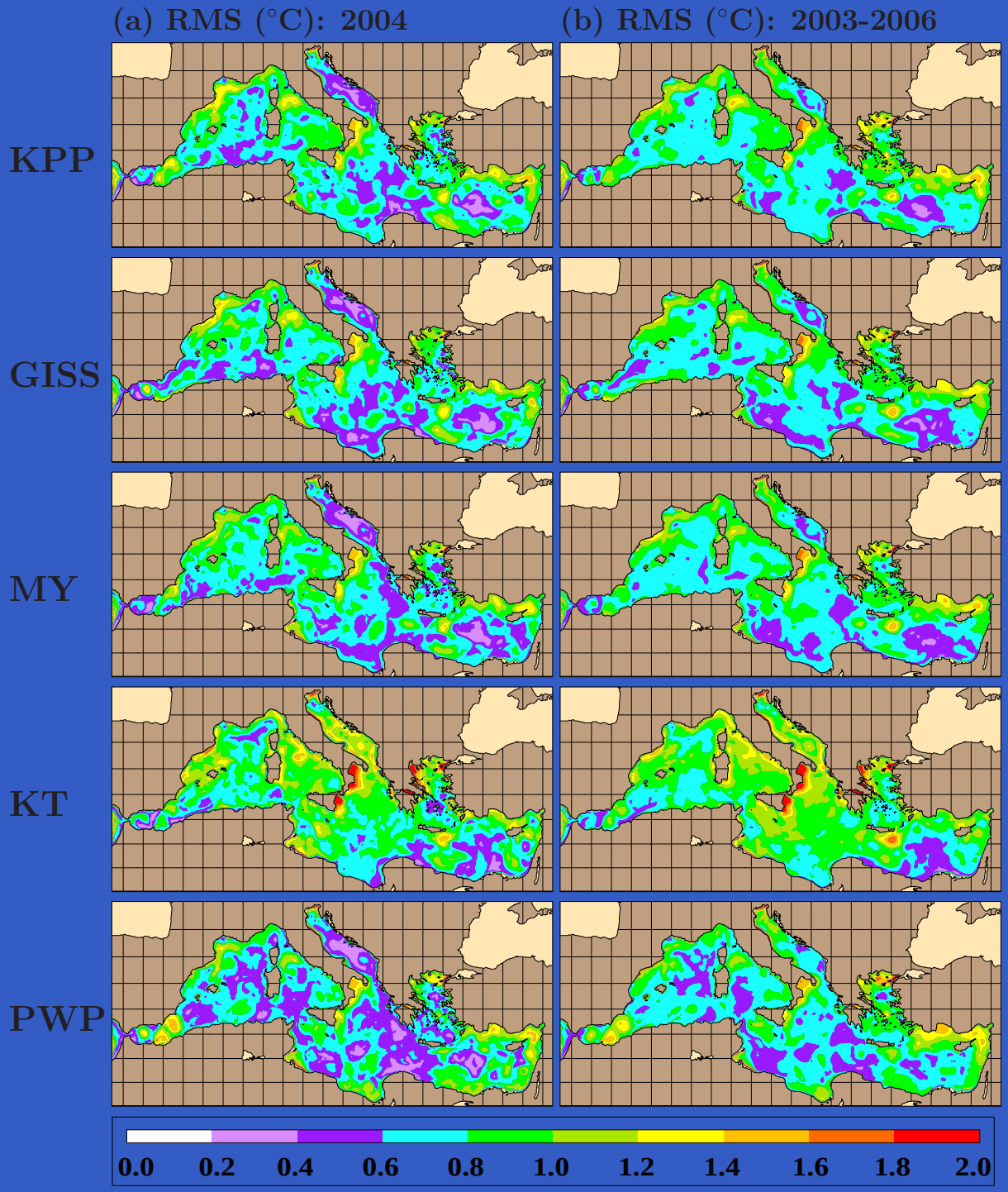


Basin–Averaged Monthly Mean SST Bias: 2003–2006



Annual mean bias is $\approx 0.1^{\circ}C$ from all models.

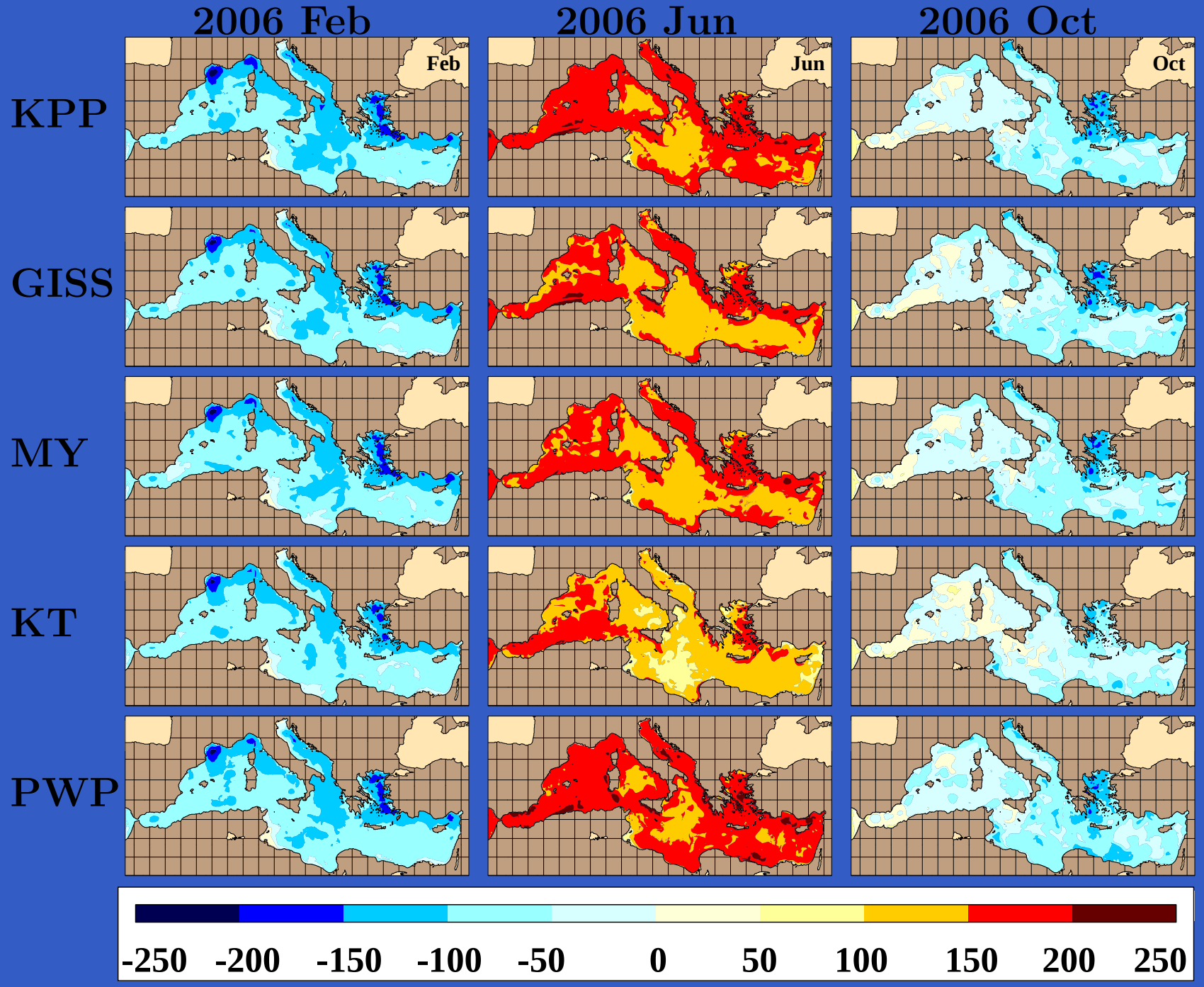
RMS SST Difference from Mixed Layer Models



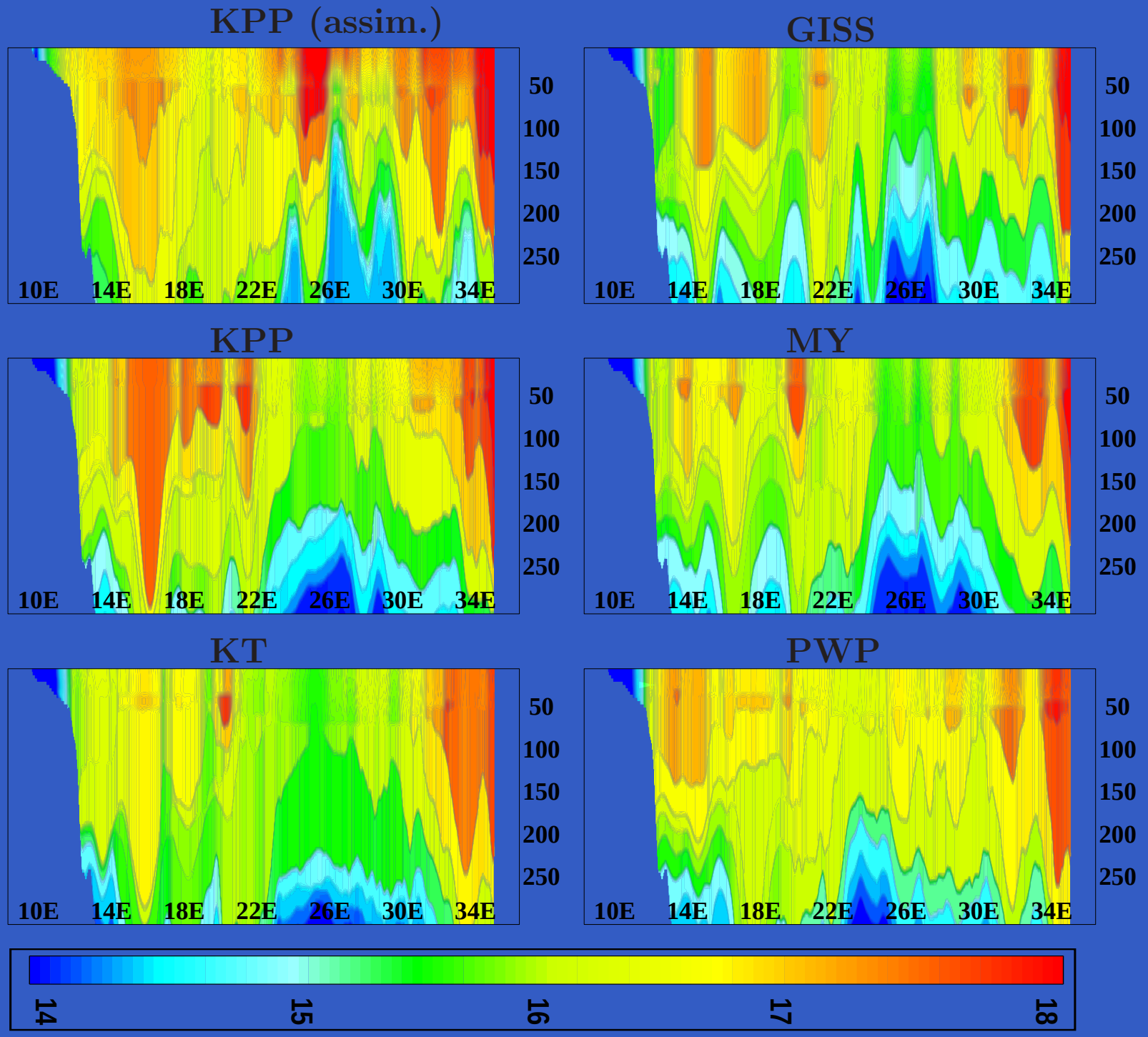
Basin–Averaged RMS SST Difference (°C) by Year

	2003	2004	2005	2006	2003-2006
KPP	0.86	0.78	0.79	0.78	0.81
GISS	0.79	0.76	0.76	0.76	0.78
MY	0.83	0.75	0.74	0.75	0.78
KT	0.88	0.88	0.90	0.96	0.91
PWP	0.90	0.73	0.74	0.73	0.79

Net surface heat flux (W m^{-2})



Subsurface temperatures (°C): February 2006



Summary and Conclusions

- All mixed layer models perform similarly:
  - validation against MODAS SST
  - $0.8^{\circ}\mathrm{C}$ RMS difference
- Upwelling from each model varies.
- Changes in the net surface heat flux
  - $50\ \mathrm{W\ m^{-2}}$ difference from KT
- Future work:
  - mixed layer depth analysis
  - comparisons to ARGO, WOA profiles